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Efficient Routing and High Security Transmission Using PBRR for Increased Enhance Network Efficiency

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Abstract: **Low energy consumption is a major design constraint for battery operated embedded systems such as wireless sensor networks or WSN. Low energy is more important compared to low power for such systems as it will increase lifetime of the system. So, minimizing energy consumption becomes the most critical factor in the design of almost all WSN protocols. For end-to-end data transmission, media access control (MAC) and routing protocols play an important role in WSNs. Besides, these protocols mostly use the hierarchical structure for end-to-end reliable data delivery. The time and energy required to generate a hierarchical structure in a sequential manner is always high. So, in order to mitigate the above challenges. In such systems, most of the energy is consumed when the radios are on, waiting for an arrival to occur. Sleep-wake scheduling is an effective mechanism to prolong the lifetime of these energy-constrained wireless sensor networks. In the proposed mechanism we will use appropriate mechanism for efficient route selection and also reducing energy consumption, sleep wake mechanism is an effective to reduce energy consumption. By using above methods, proposed results guarantees in the improvements of Energy Consumption, average delay and packet delivery ratio**.

Key words – Wireless Sensor Networks, Media Access Control

I. INTRODUCTION

Wireless Sensor network is the vibrant and emerging research area in the field of network because of its increasing application over the entire globe. Some of its application fields are surveillance in battlefield, securing home, creating spaces which is smart enough, monitoring environment, and tracking the target. Wireless Sensor Network consists of sensor nodes that will be distributed in a given area to sense or monitor the environmental or physical conditions like Sound, Temperature, and Pressure etc. A *distributed system* is a system in which components located on networked computers communicate and coordinate their actions by passing messages. There are two types of distributed networks; Dense Network and Sparse Network. A dense network is a network in which the number of links of each node is close to the utmost number of nodes. A sparse network, by contrast, is connected by a low number of links only. Sensor Network under consideration are those networks that are densely distributed.

These sensor nodes sense the environment and collect the information. These collected information will be transmitted to the destination using wireless means. Sensor nodes are nothing but nodes which is made up of radio transceiver, microcontroller and battery. Radio transceiver consists of a built in antenna or an externally connected antenna. Microcontroller is the one that will interface between the energy source and sensor device. Now the third component is the energy source, usually battery is used as energy source to sensor nodes.

Fig: 1 Traditional Sample Sensor Node

Since these sensor nodes are deployed over remote locations, and also these sensor nodes are usually installed by small battery and also once nodes are deployed, frequent recharging of battery is also not possible, hence it is very much required to utilize the power very efficiently. Major energy consumption happens on routing the information to the destination. Hence design of any protocol for WSN must be energy efficient which will increase the life time of the Network. Hence important challenge is to prolong lifetime of network.

In recent years many new concepts have been developed or designed to mitigate the consumption of energy over WSN. Major goal behind every design is to achieve reduction in energy consumption because of deployment over the remote place of sensor node to capture the information of random events and the limited energy source or constant monitoring of environment.

Once the information is collected from node, major challenge is in selection of the reliable path to destination which is of minimum cost i.e. transmission of information to destination must consume less energy. Path that is being selected must be reliable, that will transmit all the information collected by the sensor to destination with highest throughput, Packet delivery

ratio, less packet loss. Add sensing functions and reliable wireless communications to physically embedded computing devices to support ubiquitous networked computing which are billions of nodes.

In order to prolong the network lifetime, packets must be delivered with a high throughput, less delay, more Packet Delivery Ratio. In order to achieve this both MAC and routing protocols in Wireless Sensor Network plays a major role. There are several other routing protocol like S-MAC, R-MAC, and HE-MAC etc. But these protocol are not much energy efficiency in routing the packets to the destination. In order to overcome the drawbacks of the above protocols, Parameter Based Reliable Routing (PBRR) algorithm is used, which is a Multi-level routing protocol which transmit the packet through multi-hop in a single duty-cycle.

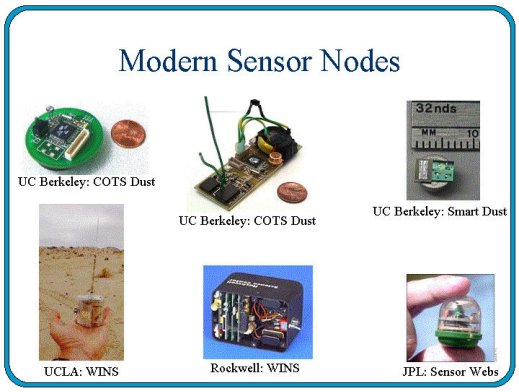

Fig:2 Other Sensor Nodes

TREE CONSTRUCTION

Once the nodes are deployed over the network, source and destination are identified; this is the important step in the construction of tree structure. Construction of tree happens in three different phases. Terms involved in this Tree Structure are:

Level : Packet has to cross number of hops which are referred to as nodes to reach the destination is called Level. In the tree structure every node is assigned with one level number and makes sure that it is reachable from that node to destination. This procedure is used to make sure that the computed path is smallest path to reach the destination.

Parent : Parent is like a leader to respective levels. In the tree structure every level is assigned with two parent nodes. Energy Level is determined to assign that nodes as a parent. All the information that are collected are transmitted to the destination through these parent nodes.

Energy Level : It is the remaining energy available in the sensor nodes to transmit the information to next node. Based on these information we are going to assign the node as parent node. Usually sensor nodes are powered by battery which is having limited energy and get drained very easily when not used properly, hence energy has to harnessed and used very carefully to increase the battery lifetime and in turn increase the network lifetime.

It is a multilevel routing algorithm, this algorithm mainly concentrates on the reduction of packet loss and Drop of packet, select the highly reliable path of network which is of best quality for data transfer. In this algorithm we consider the parameters during the selection of path from the source to destination.

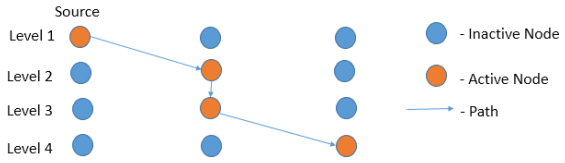

Fig:3 Sample Tree

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Packet Loss: This algorithm tries to reduce the number of packets being dropped due to No Energy in the node to transmit the packet, or insufficient buffer size to store the packet in the node and forward it to next node.

Reduction of hop count: Algorithm tries to reduce the number of hop count, which will in turn reduce the number of nodes the data has to pass through to reach the destination. By achieving the above parameter, we can reduce the energy utilization of the whole network.

Packet Error: Is the error that will be introduced in the packet to during transmission to next node.

II. METHODOLOGY

In the proposed system, Parameter Based Reliable Routing (PBRR) algorithm is used to find out the path to the destination based on parameters: energy level, hop count, free buffer size, distance between successive nodes. These algorithm uses a multi-level routing process to reduce the time required to transmit.

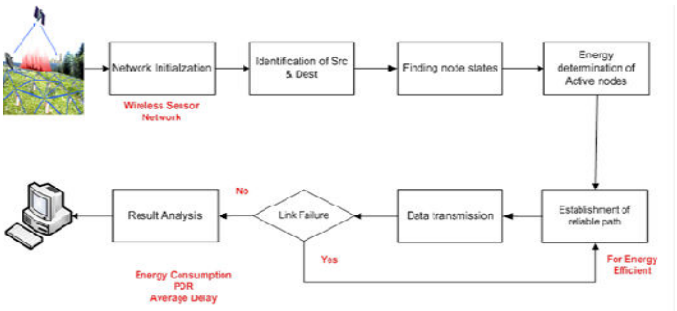

Fig: 4 Architecture for Wireless Sensor Network

Network Initialization : In this step users sets various parameter, they are

In this step nodes are deployed using random algorithm so that algorithm is independent of nodes coordinates. Random

Algorithm uses the mod operation with highest prime number, it uses prime numbers because of the reason that prime number gives more random numbers when used it for mod operatio

Identification of Source and Destination:

In this step user selects the source and destination node. Based on the user inputs, nodes that are selected are marked as source and destination, Identification purpose it is highlighted by marking with star. For analysis purposes source and destination are selected randomly by using the same algorithm as used for the node deployment so that it is easy for analysis.

Finding Node States:

In this step states of all the node are determined, in this step we will get to know regarding the states, whether the nodes are in active or in sleep or in Inactive state. This step is used to eliminate all nodes which are at Inactive state, which means which are not having sufficient energy to transmit packets to next node. This is incorporated to remove the consideration of nodes which are in dead state so that those nodes are not considered for routing the packets from source and destination.

Energy Determination of Active Nodes:

Once the states of all the nodes are determined, determination of energy levels are done for nodes that are at only active state. This is done to consider only those nodes which are capable of sending all packets which contains message to destination, hence we removing the possibility of drop of packet due to nodes failure because of battery drain. If a packet is dropped, then that packet has to be transmitted again which will consume much more energy in turn reduces the lifetime of network.

Establishment of reliable path:

In this step, Parameter Based Reliable Routing (PBRR) algorithm is used, which considers following parameters :

1. Hop Count
2. Free Buffer Size
3. Distance Between
4. Energy Level

Parameter Based Reliable Routing algorithm is used to determine the reliable path to the destination. Once the path is determined nodes which are not involved in transmission kept in sleep state to increase the network lifetime. After this step tree is constructed by keeping active nodes as parent nodes and other nodes child nodes except Source and Destination Nodes. Parameter Based Reliable Routing uses above parameter to determine the path between source and destination which can be called as efficient path because algorithm takes care of all the parameter which are likely to cause the node failure.

Data Transmission:

Once the reliable path has been selected, data is passed through the nodes from source to destination that are involved in reliable path. For every packet sent between sender and receiver, receiver has to send and acknowledgment to the sender before forwarding that packet to the next neighbor node, this process continues until that packet reaches destination. If node cannot send that packet to next node because of some reason node will acknowledge to sender saying that it cannot forward that packet to its neighbor node so that sender node finds an alternative path to the destination which can be considered as second reliable path.

Link Failure :

In case there is a link failure during transmission of information after at most care, Architecture takes care of that by finding alternative reliable path to destination from the previous hop to node failure. For finding this path Same Parameter Based Reliable Routing Algorithm is used by marking the nodes which are already in reliable path as used nodes and finding other nodes for routing remaining packets to destination.

Result Analysis:

Once the data is successfully transmitted results that are obtained are given for analysis. In this step Graphs are plotted for Network lifetime, Average Delay, Sum of Energy Consumed from transmitting nodes vs. number of nodes. It gives the details of behavior of algorithm as number of nodes increases.

III. Experimental Results

The Algorithm uses rand function to generate random number and to get more random value which are more distant apart so that nodes having coordinate values are not closely packed. Algorithm uses prime numbers while taking remainders because remainders generates more random numbers when computed with prime numbers.

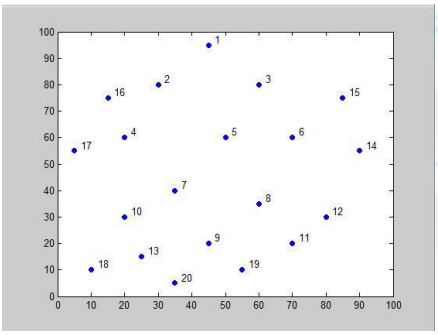

Fig:5 Node Deployment

Above algorithm uses rand function to generate random number and to get more random value which are more distant apart so that nodes having coordinate values are not closely packed. Algorithm uses prime numbers while taking remainders because remainders generates more random numbers when computed with prime numbers.

Once the network is initialized with parameters user asked for Source and Destination Selection. Below Figure shows the dialog for prompting user to take the nodes name for selecting source and destination selection.
Once user selects the source and destination are selected, node states of those are determined, for construction of tree. In the node state determination is done to ignore nodes which are in dead state so that nodes involved in path from source to destination will have sufficient energy to transmit all the packets, this step also ensures that nodes whose energy are drained completely are not involved in path so that path determination will not have once again even before transmitting single packet to destination.

Below figure shows the source and destination and selections, which is indicated by star mark on those nodes and also those nodes which are selected by user as source and destination are renamed as source and destination respectively.

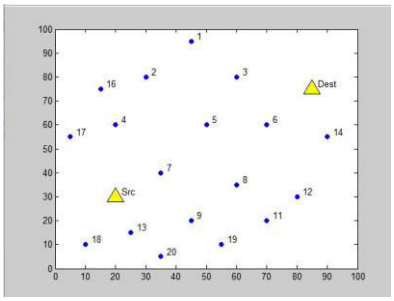

Fig:6 Representation of Source and Destination Nodes

Once the Source and destination is selected Parameter Based Reliable Routing algorithm is used in selecting the parent nodes and construction of tree. Parameter Based Reliable Routing algorithm uses only those nodes which are selected as active nodes in the node determination stage, so that algorithm will not select those node whose energy is completely drained out. These parameters increases the packet delivery ratio, network lifetime, Decrease in Energy Consumption. Below Figure shows the path from Source and Destination.

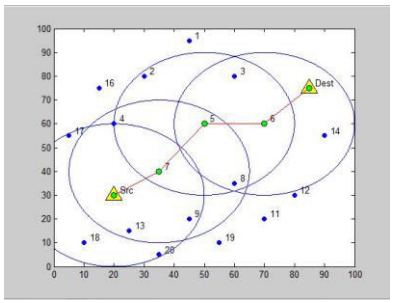

Fig:7 Route Establishment

Selection of parent nodes which are selected as active nodes is happened, route is established between source and destination based on Parameters that Parameter Based Reliable Routing Algorithm uses.

Algorithm selects the node by considering parameters like Energy Level of node, Hop count between Source and Destination, Distance between tow nodes, Available buffer size. If there is a node failure or any error in packet then acknowledgement will not be sent by the node that receives the packet.

Below figure shows the transmission of packet from one node to another node.

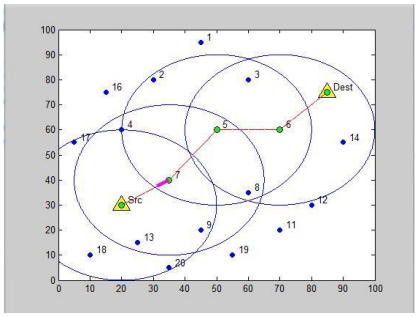

Fig: 8 Transfer of packets

Packets are transmitted between the source and destination, as packet is received by the node its duty is to send back the acknowledgement back to the sender node so that it confirms that packet has been successfully reached the receiver without any error. In case if there is a node failure after taking the utmost care in selecting the node from source to destination, user is prompted with the error message saying that there is a node failure among the node that is involved in path from source and destination.

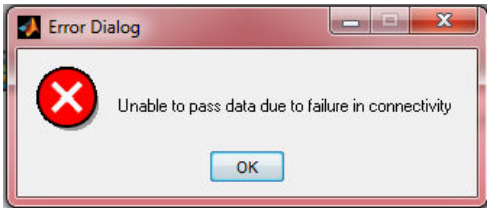

Fig: 9 Error Dialog for node Failure

Once after user is prompted algorithm also requests for finding alternative path from node before which predecessor to node that failed due to some reason.

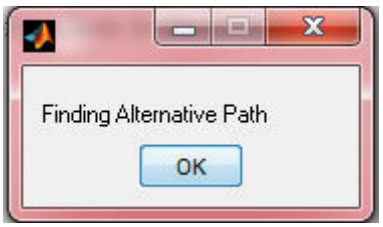

Fig: 10 Prompt user for alternate path

Once after user clicks on OK button on prompt, alternative path is found using the same Parameter Based Reliable

Routing algorithm is used to find the alternative path. It considers the same parameter that is used to find the first path.

This algorithm considers only those nodes which were not involved in path that failed by using variable that will be assigned with a bool value to check whether that node is not in path that failed.
Once alternative path is determined packets gets transmitted through that path from source to destination as seen in the above figure, even in this path is selected at most care to prevent failure of node in this path once again. The selection of path is done using same algorithm so that algorithm finds the second shortest path from previous nodes that failed due to some reason and to the destination node.

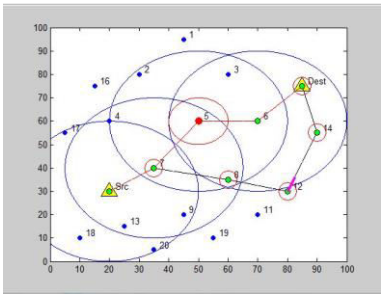

Fig: 11 Alternate Path from Source and Destination

Nodes for alternative path is selected based on the bool variable that is assigned with a value zero by default. When that node is used in path variable value is made high so that node is not selected once again for other path.

Graphs in the below screen shots indicate reduction in energy consumption when compared with existing system. Since algorithm considers various parameters that are listed in Proposed system tries to reduce the packet loss and number of hops that is involved in transmission of packets to destination.

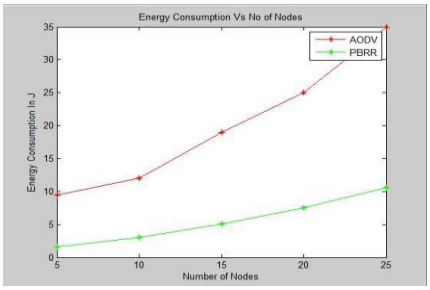

Fig 12 Graphs of Energy Consumption

Below graphs indicate the average delay in packet delivery when transmitted from source to destination. As graphs shows that decrease in average delay when compared to existing system. It is because number of hops gets reduced during the route selection process.

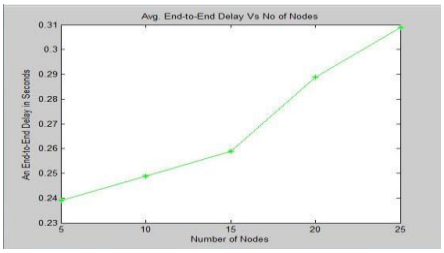

Fig: 13 Graph of Average Delay

Below graphs indicate the packet Delivery Ratio when transmitting from packets from source to destination. As graphs show increase in packet delivery ratio because of algorithm considers the parameters which identifies path which is of more reliable and shortest path from source and destination.

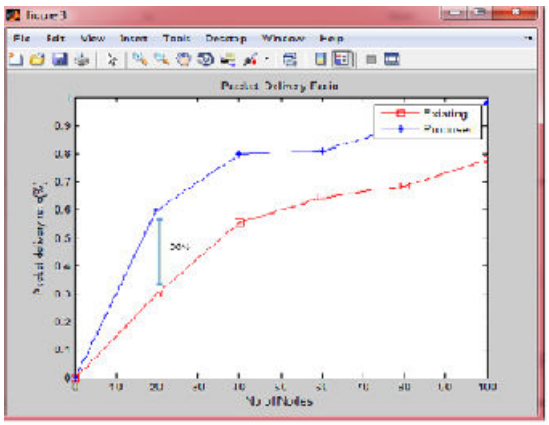

Fig: 14 Graph of Packet Delivery Ratio

Parameter Based Reliable Routing Algorithm is used in finding path from source to destination, this path is chosen based on the Parameters energy consumption, Hop Count, Free Buffer Size and Distance Between that node and destination.
In order to prove that path is shorter one some test have been conducted by finding alternative path source to destination by using the same algorithm so that algorithm finds the next path which is of second path to destination from source. In order to prove the first path as the shortest path energy consumed and delay in Packet is found in the first and second path and compared.

Serial No	Energy Consumed in First Path	Energy consumed in Second Path
1	71.33 Joules	103.16 Joules
2	98.91 Joules	117.27 Joules
3	103.03 Joules	120.45 Joules
4	87.45 Joules	110.34 Joules
5	107.62 Joules	123.61 Joules

6	78.10 Joules	134.45 Joules
7	45.56 Joules	78.21 Joules

Table: 1 Energy Consumption

Hence from above table we can get to know that energy consumed from the first path is less compared to the second path and can be proved that algorithm finds the possible shorter path to the destination from source. Energy consumption gets reduced as number of nodes involved in the path is less, hence total energy consumed in network is less. Below table compares the Packet delay latency from shortest path which was found initially to the path that was found later, in which second path is found using the same Parameter Based Reliable Routing Algorithm.

In the above and below table all the values in the column Packet Delay in First Path is less than the value compared to the values in Packet Delay in Second Path, hence it says that the path that is found is shorter path compared to other paths from source to destination

Serial No	Packet Delay in First Path (micro sec)	Packet Delay in Second Path (micro sec)
1	569	577
2	580	580
3	645	850
4	680	825
5	632	700
6	634	832
7	690	857

Table: 2 Average Packet Delay

IV Conclusion and Future Scope

This project mainly concentrates on reducing energy consumption while selecting the path to destination, starting from source. Project uses Parameter in PBRR to select the path. As algorithm suggests, it identifies the path based on parameter between the source and destination, parameter under consideration are: energy consumption, hop count, free buffer, and distance between successive nodes.

For data transmission, a more reliable and shorter path between source and destination is identified which in turn reduces the energy consumption. Compared to existing system, proposed system reduces energy consumption, increases packet delivery ratio, decreases average delay.

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